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PATENT APPLICATION

ATTORNEY DOCKET NO. 10980749-1

IN THE
UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s): John C. Eidson

Serial No.: 09/205,115

Examiner: Holloway E.

Filing Date: 12-3-98

Group Art Unit: 2635

Title: MOTION CONTROL USING TIME SYNCHRONIZATION

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ASSISTANT COMMISSIONER FOR PATENTS
PO Box 1450
Alexandria, VA 22313-1450

TRANSMITTAL OF APPEAL BRIEF

Sir:

Transmitted herewith in triplicate is the Appeal Brief in this application with respect to the Notice of Appeal filed on **1-2-04**   .

The fee for filing this Appeal Brief is (37 CFR 1.17(c)) $330.00.

(complete (a) or (b) as applicable)

The proceedings herein are for a patent application and the provisions of 37 CFR 1.136(a) apply.

( ) (a) Applicant petitions for an extension of time under 37 CFR 1.136 (fees: 37 CFR 1.17(a)-(d) for the total number of months checked below:

( ) one month	$110.00	
( ) two months	$420.00	
( ) three months	$950.00	
( ) four months	$1480.00	

( ) The extension fee has already been filled in this application.

(X) (b) Applicant believes that no extension of term is required. However, this conditional petition is being made to provide for the possibility that applicant has inadvertently overlooked the need for a petition and fee for extension of time.

Please charge to Deposit Account 50-1078 the sum of **$330.00**   . At any time during the pendency of this application, please charge any fees required or credit any overpayment to Deposit Account 50-1078 pursuant to 37 CFR 1.25.

(X) A duplicate copy of this transmittal letter is enclosed.

(X) I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Commissioner for Patents, PO Box 1450, Alexandria, VA 222313-1450.
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Typed Name: **Paul H. Horstmann**
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Respectfully submitted,

John C. Eidson

By _____
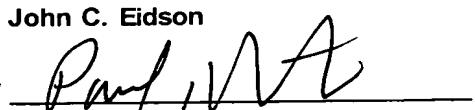
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Date: **3-2-04**
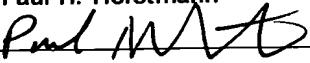
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Rev 10/03 (Aplbrief)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re Application of:)
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John C. Eidson)
)
Application No: 09/205,115)
)
Filed: 12-3-98)
)
For: MOTION CONTROL USING TIME)
SYNCHRONIZATION)
)

Examiner: Holloway E

Art Unit: 2635

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Paul H. Horstmann
Name of Person Mailing Correspondence

_____ 3-2-04
Signature   Date

Appellant's Brief (Pursuant to 37 C.F.R. §1.192)

Dear Sir:

Applicant/Appellant submits this Appeal Brief in connection with the above-referenced patent application which is on appeal to the Board of Patent Appeals and Interferences.

TABLE OF CONTENTS

REAL PARTY IN INTEREST

The real party in interest in this application is Agilent Technologies, Inc.

RELATED APPEALS AND INTERFERENCES

Appellant is unaware of any other related appeals or interferences that may directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

STATUS OF THE CLAIMS

Claims 18-37 stand rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 5,146,410 of *Kawamura et al.* ("*Kawamura*") and U.S. Patent No. 5,566,180 of *Eidson et al.* ("*Eidson*").

Claims 18-37 stand rejected under 35 U.S.C. §103(a) as being unpatentable over *Kawamura* and *Eidson* and U.S. Patent No. 4,514,814 of *Evans* ("*Evans*").

Appellant appeals the rejection of all of the pending claims 18-37. Claims 18-37 as currently pending are set forth in the attached Appendix.

STATUS OF AMENDMENTS

Appellant is unaware of any amendments filed after the Final Office Action mailed 10/2/03 which finally rejected claims 18-37.

SUMMARY OF THE INVENTION

Claims 18-37 are directed to a motion control system having a set of control nodes that are coordinated using network communication and time synchronization. Each control node controls the motion of only a single axis of a motion control system so that the amount of control node hardware deployed may be matched to the number of motion axes being controlled. The motions of multiple axes are coordinated by associating a trigger time to each control value to be applied to the axes and by providing the control nodes with network communication and synchronized clocks for triggering the application of the control values to the axes.

ISSUE PRESENTED

I: Whether claims 18-37 are obvious in view of *Kawamura* and *Eidson*.

II: Whether claims 18-37 are obvious in view of *Kawamura* and *Eidson* and *Evans*.

GROUPING OF CLAIMS

Claims 18-22 and 27-37 stand together (Group I). Claims 23-26 stand together (Group II).

ARGUMENT

I: Claims 18-37 are not obvious in view of *Kawamura* and *Eidson* because *Kawamura* and *Eidson* do not disclose or suggest the limitations of claims 18, 23, 27, and 35.

Appellant respectfully submits that claims 18, 23, 27, and 35, and

claims 19-22, 24-26, 28-34, and 36-37 which depend from claims 18, 23, 27, and

35, respectively, are not obvious under 35 U.S.C. §103 in view of *Kawamura*

and *Eidson* because *Kawamura* and *Eidson* do not disclose or suggest the

limitations in claims 18, 23, 27, and 35 that are directed to a motion control

system having a set of single-axis control nodes that are coordinated using

network time synchronization. *Kawamura* and *Eidson* do not disclose or

suggest a control node for controlling a single axis of a motion control system

as claimed in claims 18, 23, 27, and 35. *Kawamura* and *Eidson* do not disclose or

suggest a control node that applies a control value to an axis of a motion

control system when a trigger time associated with the control value matches

a time in a clock in the control node as claimed in claims 18, 23, 27, and 35.

Kawamura and *Eidson* do not disclose or suggest coordinating the application

of control values to multiple axes of a motion control system by associating

trigger times to the control values as claimed in claims 18, 23, 27, and 35.

Appellant further submits that claim 23, and claims 24-26 which depend from

claims 23, are not obvious under 35 U.S.C. §103 in view of *Kawamura* and

Eidson because *Kawamura* and *Eidson* do not disclose or suggest the further

limitations in claim 23 of a selector node and tables in the control nodes.

A. *Kawamura* and *Edison* do not disclose or suggest a control node for controlling a single axis of a motion control system as claimed in claims 18, 23, 27, and 35.

Appellant submits that *Kawamura* does not disclose or suggest a control

node for controlling a single axis of a motion control system as claimed in

claims 18, 23, 27, and 35. Instead, *Kawamura* discloses a control apparatus 20

for controlling <u>three</u> axes of a motion control system (*Kawamura*, col. 2, lines

18-21). Figure 1 of *Kawamura* shows three axis control circuits in the control apparatus 20 and *Kawamura* clearly states that

> A programmable machine controller (PMC) 10 is coupled to a computerized numerical control (CNC) apparatus 20 and issues command signals <u>for controlling three axes of the CNC apparatus 20</u>.

(*Kawamura*, col. 2, lines 18-21) (emphasis added).

The control apparatus 20 of *Kawamura* is an example of a prior art motion control card that includes hardware for controlling multiple axes. Appellant's Specification discusses a variety of shortcoming of such multiple axis control cards, e.g. the waste of unused control card hardware. (See page 3-4 of Appellant's Specification). The shortcomings of such prior art multiple axis control cards are overcome by a control node that controls a single axis of a motion control system as claimed in claims 18, 23, 27, and 35, by enabling the deployment of one control node for each axis of a motion control system without wasting control node hardware.

The Examiner has stated that

> axis control circuits 24-26 of Kawamura each form a circuit <u>or node</u> for controlling motion in a single axis.

(Page 4, Office Action, 10/2/03) (emphasis added).

Appellant submits that the axis control circuits 24-26 of *Kawamura* are not control nodes that are responsive to information obtained via a network as are the control nodes claimed in claims 18, 23, 27, and 35. Instead, *Kawamura* states that

> Axis control circuits 24, 25, 26 are responsive to commands from the buffers 21, 22, 23...

(*Kawamura*, col. 2, lines 26-27) and Figure 1 of *Kawamura* clearly shows that buffers 21-23 are contained in the control apparatus 20 along with the axis control circuits 24-26. Moreover, the commands in the buffers 21-23 of *Kawamura* are sent from the programmable machine controller 10 to the control apparatus 20 via a common RAM. (*Kawamura*, col. 2, lines 22-24). In contrast, a control node of claims 18, 23, 27, and 35 controls only a single axis and obtains information for controlling its axis via a network.

Eidson does not disclose or suggest a control node for controlling a single axis of a motion control system as claimed in claims 18, 23, 27, and 35.

B. *Kawamura* and *Eidson* do not disclose or suggest a control node that applies a control value to an axis of a motion control system when a trigger time associated with the control value matches a time in a clock in the control node as claimed in claims 18, 23, 27, and 35.

Appellant submits that *Kawamura* does not disclose or suggest a control node that applies a control value to an axis of a motion control system when a trigger time associated with the control value matches a time in a clock in the control node as claimed in claims 18, 23, 27, and 35. Instead, *Kawamura* discloses a control apparatus 20 that starts applying pulses to its axis when all commands are received by the control apparatus 20. (*Kawamura*, col. 1, lines 59-64). For example, *Kawamura* provides

> When all commands for the axes in the respective groups are received by the computerized numerical control apparatus (20), pulses start to be distributed to the axes...

(*Kawamura*, Abstract, lines 9-12) (emphasis added).

Moreover, *Kawamura* does not disclose a trigger time associated with a control value or a clock in the control apparatus 20 that holds a time that may be compared to a trigger time as claimed in claims 18, 23, 27, and 35.

The Examiner has stated that *Kawamura* teaches that movement is triggered by the programmed execution times Ta and Te. (Pages 5-6, Office Action, 10/2/03). Appellant respectfully submits, however, that the execution times Ta and Te of *Kawamura* are not trigger times as claimed in claims 18, 23, 27, and 35. Instead, the execution times Ta and Te of *Kawamura* are time intervals for distributing pulses. (*Kawamura*, Abstract, lines 12-13). (For example, *Kawamura* discloses

> means for ... distributing the pulses within the execution times to effect linear interpolation with respect to the axes.

(*Kawamura*, col. 1, lines 59-64) (emphasis added) and states that

> since the second and third axes of the group B execute commanded motions during the given time Te, linear interpolation is effected...

(*Kawamura*, col. 2, lines 37-40) (emphasis added). It is submitted that the pulses of *Kawamura* are triggered by the receipt of commands from the programmable machine controller 10 and that the pulses are thereafter confined to the execution time intervals Ta and Te after being triggered by the commands.

Eidson does not disclose or suggest a control node that applies a control value to an axis of a motion control system when a trigger time associated with the control value matches a time in a clock in the control node as claimed in claims 18, 23, 27, and 35.

C. *Kawamura* and *Eidson* do not disclose or suggest coordinating the application of control values to multiple axes of a motion control system by associating trigger times to control values as claimed in claims 18, 23, 27, and 35.

Appellant submits that *Kawamura* does not disclose or suggest coordinating the application of control values to multiple axes of a motion control system by associating trigger times to control values as claimed in claims 18, 23, 27, and 35. Instead, *Kawamura* teaches that multiple axes may be started at the same time by grouping together axes. (*Kawamura*, col. 1, lines 65-68). For example, *Kawamura* states that

> In FIG. 1, a first axis belongs to a group A, and second and third axes to a group B. Command values for the second and third axes are stored in the buffers 22,23 and simultaneously start to be distributed for enabling the second and third axes to start moving at the same time.

(*Kawamura*, col. 2, lines 30-35).

The grouping of the buffers 22 and 23 in the control apparatus 20 as taught by *Kawamura* is an example of a prior art technique for coordinating multiple axes using tight coupling of registers in a control card. Appellant's Specification discusses a variety of shortcoming of such prior art control cards (See page 3-4 of Appellant's Specification) that are overcome by a motion control system as claimed in claims 18, 23, 27, and 35.

Eidson discloses clock synchronization for nodes in a distributed network (*Eidson*, col. 2, lines 46-48) rather than coordinating the application of

control values to the axes of a motion control system as claimed in claims 18, 23, 27, and 35.

D. Even assuming arguendo that *Kawamura* and *Eidson* suggest a control node with a synchronized clock, claims 18, 23, 27, and 35 are still not obvious because the prior art does not provide a motivation to combine the teachings of *Kawamura* and *Eidson*.

An obviousness rejection based on a combination of references is improper in the absence of a motivation to combine the references. In re Rouffet, 149 F.3d 1350, 1357, 47USPQ2d 1453, 1457-58 (Fed. Cir. 1998). The mere fact that references can be combined does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. In re Mills, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990). Appellant submits that one of ordinary skill in the art would not be motivated to combine *Eidson* with *Kawamura* because *Eidson* teaches synchronizing the local clocks in the distributed nodes of a network (*Eidson*, col. 2, lines 37-43) whereas the control system of *Kawamura* includes a programmable machine controller 10 and a control apparatus 20 that communicate via a common RAM. (*Kawamura*, col. 2, lines 22-24) rather than a distributed network.

The Examiner has stated that it would have been obvious to include synchronized clocks as taught by *Eidson* with the axis control circuits 24-26[1] of *Kawamura*. (Page 3, Office Action, 10/2/03). Appellant respectfully submits that one of ordinary skill in the art would not be motivated to provide each access control circuit 24-26 of *Kawamura* with its own synchronized clock as taught by *Eidson* because the access control circuit 24-26 are contained in the same control apparatus 20 and are not subject to network latency and jitter that the teachings of *Eidson* are intended to overcome. (*Eidson*, col. 1, lines 47-55). It is further submitted that one of ordinary skill in the art would not be motivated to provide each access control circuit 24-26 of *Kawamura* with its own clock because the access control circuit 24-26 are contained in the same

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[1] Appellant has already shown that the axis control circuits 24-26 of *Kawamura* are not nodes on a network as claimed in claims 18, 23, 27, and 35.

control apparatus 20 and could therefore share a clock. Appellant further submits that the Examiner is using hindsight based on Appellant's own disclosure to reconstruct Appellant's own invention by arguing that multiple synchronized clocks would be obvious to include in the control apparatus 20 of *Kawamura*. *Kawamura* does not disclose any type of clock in the control apparatus 20 or the comparison of a trigger time to a time in a clock as claimed in claims 18, 23, 27, and 35.

E. *Kawamura* and *Eidson* do not disclose or suggest a control node having a table for holding pre-computed control values and corresponding trigger times and a selector node as claimed in claim 23.

Appellant respectfully submits that claim 23, and claims 24-26 which depend from claim 23, are not obvious under 35 U.S.C. §103 in view of *Kawamura* and *Eidson* because *Kawamura* and *Eidson* do not disclose or suggest the limitations in claim 23 of a control node having a table for holding pre-computed control values and corresponding trigger times for a motion control function and a selector node that uses network communication to specify the motion control function to be performed by the control node. Rather than store control values and trigger times in a local table as claimed in claim 23, the control apparatus 20 of *Kawamura* obtains its commands from the programmable machine controller 10. (*Kawamura*, col. 2, lines 18-24). In further contrast, the control apparatus 20 of *Kawamura* obtains execution <u>time intervals</u>[2] from the programmable machine controller 10 (*Kawamura*, col. 1, lines 59-64, col. 2, lines 37-40) rather than store trigger times in a table as claimed in claim 23.

The Examiner has stated that the command values stored by *Kawamura* suggest a table. (Page 7, Office Action, 10/2/03). Appellant submits that the command values stored in the buffers 21-23 of *Kawamura* are command values sent from the programmable machine controller 10. (*Kawamura*, col. 2, lines

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[2] Appellant has shown that the execution time intervals Ta and Te of *Kawamura* are not trigger times as claimed in claim 23.

23-26). In contrast, the selector node of claim 23 sends information that specifies a motion control function to be performed and the control node in response obtains pre-computed control values and trigger times for the specified motion control function from its local table.

II: Claims 18-37 are not obvious in view of *Kawamura* and *Eidson* and *Evans* because *Kawamura* and *Eidson* and *Evans* do not disclose or suggest the limitations of claims 18, 23, 27, and 35.

Appellant respectfully submits that claims 18, 23, 27, and 35, and claims 19-22, 24-26, 28-34, and 36-37 which depend from claims 18, 23, 27, and 35, respectively, are not obvious under 35 U.S.C. §103 in view of *Kawamura* and *Eidson* and *Evans* because *Kawamura* and *Eidson* and *Evans* do not disclose or suggest the limitations in claims 18, 23, 27, and 35. Appellant has already shown that *Kawamura* and *Eidson* do not disclose or suggest a control node for controlling a single axis of a motion control system and that applies a control value to an axis of a motion control system when a trigger time associated with the control value matches a time in a clock in the control node and coordinating the application of the control values to multiple axes of a motion control system by associating trigger times to control values as claimed in claims 18, 23, 27, and 35.

Evans does not disclose or suggest a control node for controlling a single axis of a motion control system as claimed in claims 18, 23, 27, and 35. Instead, *Evans* discloses a set of axis boards (Fig. 1 of *Evans*) each for controlling multiple axes (*Evans*, col. 3, lines 1-6). Figure 3B of *Evans* shows a set of three axis control computers and a set of three servo interfaces on one axis board.

Furthermore, *Evans* does not disclose or suggest a control node that applies a control value to an axis of a motion control system when a trigger time associated with the control value matches a time in a clock in the control node and coordinating the application of the control values to multiple axes of a motion control system using trigger times for control values as claimed in claims 18, 23, 27, and 35. Instead, the axes of *Evans* are arranged into motion groups and a supervisory processor is used to coordinate each motion group. (*Evans*, col. 2, lines 14-27).

Appellant has also shown that *Kawamura* and *Eidson* do not disclose or suggest the further limitations in claim 23 of a selector node and tables in the control nodes. *Evans* does not disclose or suggest a control node having a table for holding pre-computed control values and corresponding trigger times for a motion control function and a selector node that uses network communication to specify the motion control function to be performed by the control node as claimed in claim 23. Rather than store pre-computed control values in a control node for an axis as claimed in claim 23, *Evans* transfers motion data to axis boards on a demand-driven basis. (*Evans*, Col. 2 lines 23-25).

CONCLUSION

Appellant respectfully submits that the stated rejections cannot be maintained in view of the arguments set forth above. Appellant respectfully submits that all of the claims 18-37 are patentable under 35 U.S.C. §103 over the references cited by the Examiner and requests that the Board of Patent Appeals and Interferences direct allowance of the rejected claims.

Respectfully submitted,

By

Date: 5-2-04
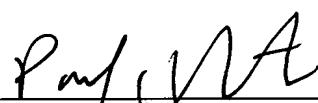
Paul H. Horstmann
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APPENDIX

18.   A motion control system comprising a set of control nodes each for controlling motion along a single axis of the motion control system, each control node having a clock and each obtaining a set of information via a network that pertains to a control value to be applied to the corresponding axis and in response each control node applying the corresponding control value to the corresponding axis when a trigger time associated with the corresponding control value matches a time in the corresponding clock such that application of the control values to the axes is coordinated by the trigger times and synchronizing the times in the clocks.

19.   The motion control system of claim 18, wherein each set of information specifies the trigger time and the control value for the corresponding axis.

20.   The motion control system of claim 18, wherein each set of information specifies a set of equations for determining the trigger time and control value for the corresponding axis.

21.   The motion control system of claim 20, wherein each control node includes a set of processing resources for determining the trigger time and the control value in response to the corresponding set of equations.

22.   The motion control system of claim 21, wherein the processing resources of each control node are scaled in response to the corresponding equations.

23.   A motion control system comprising:

    a set of control nodes each for controlling motion along a single axis of the motion control system, each control node having a clock and a set of tables each for holding a set of pre-computed control values and

corresponding trigger times for a corresponding set of motion control functions of the corresponding axis;

selector node that transfers a set of information to each control node via the network that specifies one of the motion control functions to be performed in the corresponding axis such that each control node in response to the corresponding information obtains a control value for the specified motion control function from the corresponding tables and applies the control value to the corresponding axis when the corresponding trigger time matches a time in the corresponding clock such that the motion control functions of the axes are coordinated by the trigger times in the tables and synchronizing the times in the clocks.

24.   The motion control system of claim 23, wherein the pre-computed control values and trigger times are generated by the selector node and transferred to the control nodes via the network.

25.   The motion control system of claim 23, wherein the pre-computed control values and trigger times are generated by a set of processing resources in each control node.

26.   The motion control system of claim 23, wherein each set of information identifies a subset of the corresponding tables and a starting time such that each control node obtains the control value and the trigger time from the identified tables and applies the control value in accordance with the corresponding specified starting time.

27.   A method for controlling a set of axes of a motion control system, comprising the steps of:

for each axis, obtaining a set of information via a network that pertains to a control value to be applied to the axis;

for each axis, applying the control value to the axis when a trigger time associated with the control value matches a time in a clock associated with the axis such that application of the control values to the axes is coordinated by the trigger times and synchronizing the times in the clocks.

28. The method of claim 27, wherein one or more of the sets of information specifies the trigger time and the control value for the corresponding axis.

29. The method of claim 27, wherein one or more of the sets of information specifies a set of equations for determining the trigger time and control value for the corresponding axis.

30. The method of claim 29, further comprising the step of determining the trigger time and the control value in response to the corresponding set of equations.

31. The method of claim 30, further comprising the step of scaling a set of processing resource for the corresponding axis in response to the corresponding equations.

32. The method of claim 27, further comprising the step of generating a set of pre-computed control values and trigger times for each axis.

33. The method of claim 32, wherein each set of information specifies a subset of the pre-computed control values and trigger times and a starting time.

34. The method of claim 33, further comprising the steps of for each axis obtaining the control value and the trigger time from the specified subset and

applying the control value in accordance with the corresponding specified starting time.

35.   A motion control system, comprising:

first control node for controlling a motion of a first axis of the motion control system, the first control node having a first synchronized clock and means for triggering the motion of the first axis when a trigger time associated with the first axis matches a time in the first synchronized clock;

second control node for controlling a motion of a second axis of the motion control system, the second control node having a second synchronized clock and means for triggering the motion of the second axis when a trigger time associated with the second axis matches a time in the second synchronized clock;

such that the motions of the first and second axes are started at substantially the same time by setting each trigger time equal to a starting time.

36.   The motion control system of claim 35, wherein the starting time is sent to the first and second control nodes via a network.

37.   The motion control system of claim 36, wherein a set of control values associated with each motion is sent to the first and second control nodes via the network.